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ALBERT FREDERICK HILL
STUART KIMBALL HARRIS
RALPH CARLETON BEAN
RICHARD ALDEN HOWARD
CARROLL EMORY WOOD, JR.
} Associate Editors

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THE NEW ENGLAND BOTANICAL CLUB

Vol. 54 September, 1952 No. 645

A TECHNIQUE FOR MORPHOLOGICAL ANALYSIS IN POPULATION STUDIES

JOHN W. VOIGT

IN the analysis of a population, the taxonomist is generally concerned with the determination of whether the population contains two or more segregates or only one variable (Davidson, 1947). In such analysis whether the results are shown by graphs, curves, or polygonal projection, the "keying" characteristics are used. In most infraspecific categories the number of such keying characteristics is not often reduced to less than the minimum of three required for polygonal graphing which is considered to be the best type of graph for portrayal of results of such analysis.

In some specific and subspecific taxa there are two distinct leaf shapes and two distinct habitats. Leaf shape may be environmentally induced or genetically fixed (ecotype or ecospecies). Complete biosystematic methods of study are necessary for this determination and subsequent settlement of taxonomic status. If the morphology of the plant is environmentally controlled the two plants have a common morphology when both are grown under uniform culture conditions. This is well established by the researches of Turesson (1922) and by Clausen, Keck, and Hiesey (1940). The main factor for the change in leaf shape may be determined by ecological study. Often light is the factor. In some studies traced outlines of leaves have been presented as evidence of morphological change without an outline of what the leaf looked like to start with or statement of whether it was a mature leaf or an immature one.

A method of determining the degree of morphological change is suggested which eliminates more of the subjective interpreta-

tion of the degree of leaf shape change than to compare the outlines. Measurements may be obtained which could be used for polygonal graphing or straight numerical comparisons. Examples of measurements that could be used are blade length/petiole length, blade length/blade width, the angle at which the blade contracts to the petiole, and scape length/leaf length. Many measurements should be made from random samples obtained in mass collection within the population for determination of the variation within the population. Usually floral characters will be used, but in some taxa the vegetative characters are more useful. Only older and mature leaves should be used as it has been reported (Brown, 1944) that greater variation in shape is to be found in immature leaves. Where it is desired to show the amount of morphological change with changed habitat conditions, the plants should be cloned, or, if this is impossible, the leaves should be measured as the individuals are planted and preserved on herbarium sheets when vegetative growth is complete. After a season, or two seasons, of growth the leaves can be compared with those of the same order at the start of the experiment.

In a leaf that tapers to join the petiole (Fig. 1. A), it is difficult to determine just where the blade ends and the petiole begins. This determination is not so difficult in leaf B, fig. 1, because of the abruptly contracted blade at the juncture of blade and petiole. To eliminate subjective impressions of such a point the curve made by the taper or contraction of the blade to the petiole is used in the following manner. Ten per cent of the distance *a–d* is marked at *c* (Fig. 1). A right triangle is laid so that the edge passes through the point *a–c*. By laying a ruler or straight edge along the right hand margin of the triangle and sliding the triangle upward the top edge of the triangle strikes a tangent to the curve at point *e*. Point *e* is considered the lowermost extent of the blade. This method has been adapted from the plant sociological method of determining an adequate sample known as the species-area curve (Cain, 1938). The ten per cent values are those which Cain states in his experience give the best results.

The worth of the method, regardless of using the ten per cent value or another arbitrarily selected, is in making the analysis more objective. As an added criterion of change in leaf shape the angle of contraction of blade to the petiole may be measured (angle *a–e*) with a protractor.

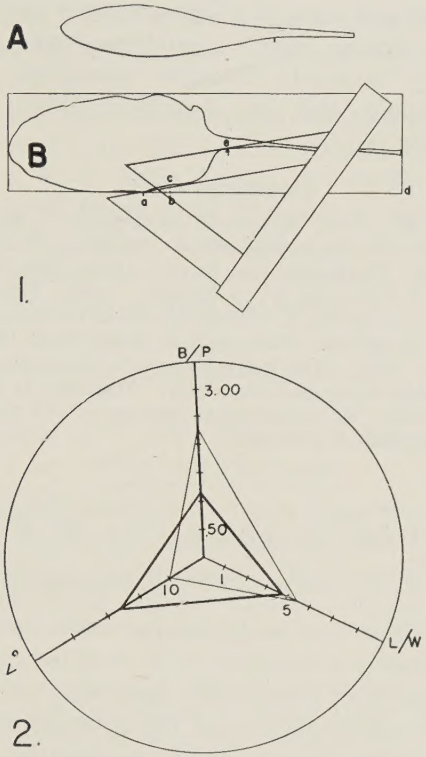

Fig. 1. (top) Leaves of a species (A), and a leaf from one of its infraspecific taxa (B). The method of determining blade length of leaves which have blades tapering to the petiole is shown. Ten per cent of the distance *a–d* is marked at *b*, and ten per cent of one-half the width of the leaf (the approximate height of the curve *a–c–e*) is marked at the point *c*. A right triangle is laid across the points *a–c*, and by sliding the triangle along a straight edge held at the right, the triangle strikes a tangent to the curve at point *e*. This point is considered to be the lowermost extent of the blade.

Fig. 2. (bottom) A polygonal graph showing the blade-petiole index (B/P), the angle of contraction of the blade to the petiole (<) and the length / width ratio (L/W) for leaf A (light line) and for leaf B (heavy line). Leaves A and B referred to are from Fig. 1, and are tracings of actual leaves. The angle of contraction of the blade to the petiole for each has been figured by the method shown and described by Fig. 1.

A polygonal graph for simultaneous portrayal of three variables found in the two leaves (Fig. 1 A & B) is given in Fig. 2. Where the lines cross each other more than once, there is an indication of more remote relation than where the lines are chiefly parallel (Davidson, 1947). When plants are reciprocally transplanted or where the plants of the taxa are grown in the same environment

and are graphed and there is a high degree of parallelism to the lines, then the change may be safely assumed to have been environmentally induced. Straight numerical measurement comparisons would also be objective.—DEPT. OF BOTANY, SOUTHERN ILLINOIS UNIVERSITY.

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CONTRIBUTIONS TO THE FLORA OF NOVA SCOTIA

E. C. SMITH AND W. B. SCHOFIELD

NORTHERN Cape Breton Island has been noted by various botanists to contain a relatively rich "isolated flora." Few recent discoveries have been made there due, no doubt, to the relatively inaccessible nature of the interior of the northern plateau. The following lists of plants collected mainly in this area add a number of arctic-montane species to the provincial flora and indicate the desirability of an extended study of this element in Nova Scotia. With this in mind, various phytogeographical comments have been omitted from the present paper.

The annotated lists below are mainly the result of exploration in Cape Breton Island during the summer of 1951. This exploration was carried out as part of a detailed ecological survey of the forests of the area, a survey sponsored by the Nova Scotia Research Foundation. Some of the taxonomic results of earlier surveys for the Foundation have been reported by D. S. Erskine (1951).

Grateful acknowledgement is made to the following persons: to W. G. Dore of the Central Experimental Farm, Ottawa, for critical determination of the *Gramineae;* to B. Boivin of the Cen-

tral Experimental Farm, H. J. Scoggan of the National Herbarium, Ottawa, and to D. S. Erskine for aid in the determination of various specimens.

Throughout the paper various abbreviations are used. 1. The forest ecology parties (a) SSSB; E. C. Smith, W. B. Schofield, D. R. Sampson, F. C. Bent in 1951; (b) SCBS: E. C. Smith, E. H. Collins, J. M. Bruce, D. R. Sampson in 1949; (c) SCBSB: E. C. Smith, E. H. Collins, J. M. Bruce, D. R. Sampson, F. C. Bent in 1950; (d) SECS: E. C. Smith, D. S. Erskine, E. H. Collins, W. B. Schofield in 1948; (e) SESB: E. C. Smith, D. S. Erskine, D. R. Sampson, F. C. Bent in the spring of 1951. 2. DAO: Department of Agriculture, Ottawa.

1. Records of Plants Previously Unreported from the Province

Of the investigated areas in Northern Cape Breton, that of the Big Southwest Brook, Inverness County, yielded the greatest number of new and rare species. The cool, moist limestone cliff walls of this brook added a habitat to those known in the province.

Woodsia alpina (Bolton) S. F. Gray (*W. Belli* (Lawson) A. E. Porsild) Although reported for Nova Scotia by Roland (1947), the species there referred to is probably *W. glabella* R. Br. (Roland, 1941.) Abundant on dry cliff of brook, North Aspy River near Cabot Trail, *SSSB 4522.*

Typha latifolia L., forma ambigua (Sonder) Kronf. This form is undoubtedly more common than the following records suggest. Colchester County: shallow pool in excavated area, roadside near Kemptown, *SSSB 4807;* Inverness County: swamp, Big Intervale, Margaree, *SCBS 2791;* Hants County: roadside ditch, Walton, *J. S. Erskine 51.113.*

Festuca prolifera (Piper) Fern. Inverness County: very rare on wet slope near large waterfall, Big Southwest Brook, south-west branch, *SSSB 4545.*

Festuca prolifera (Piper) Fern., var. lasiolepis Fern. Victoria County: very abundant in cliff crevices near waterfall, Gray Glen Brook, north branch, *SSSB 4441.*

Poa glauca Vahl. Another range gap is closed by the following collection, Inverness County: occasional on limestone cliffs in moist shaded situations, Big Southwest Brook, *SSSB 4583;* "not exactly like the *P. glauca* of arctic regions" (Dore, *in litt.*)

Scirpus cespitosus L., var. delicatulus Fern. The variety *callosus* Bigel. is widely distributed in Nova Scotia, being particularly conspicuous near the Atlantic coast and forming a major element of the vegetation in

bogs (e. g. Brier Island, Digby County and Northern Cape Breton Island). The variety *delicatulus* is locally abundant, festooning dripping limestone cliffs, Big Southwest Brook, Inverness County, *SSSB 4578*.

Rhynchospora capillacea Torr., forma leviseta (E. J. Hill) Fern. Inverness County: growing abundantly in alkaline bog in association with *Eleocharis pauciflora* var. *Fernaldii*, Black River, *SSSB 4969*. This should be sought elsewhere in similar habitats.

Betula glandulosa Michx. This species, which superficially resembles *B. pumila* L., may be commoner than the following collection suggests. Victoria County: near margin of Twin Island Lake, Ingonish Barrens at an elevation of 1300 feet, *SSSB 4623*. Here it was luxuriant in a colony of considerable extent.

Oxyria digyna (L.) Hill. This interesting plant, of wide distribution in the arctic, was a surprising addition to the flora of the province. Inverness County: locally abundant on shelves of dripping cliffs, Big Southwest Brook, *SSSB 4550*. The plants were very vigorous and differed from much arctic material in that they were almost devoid of red coloring and the leaves were relatively flaccid.

Saxifraga aizoides L. Inverness County: luxuriant on dripping limestone cliffs, Big Southwest Brook, *SSSB 4555*.

Vaccinium ovalifolium Sm. (*V. chamissonis* Bong.) Victoria County: shaded banks of Glasgow Brook, near falls, *SSSB 4289*. A single but very vigorous colony was seen in ascending Glasgow Brook to its source. This was growing in a sheltered moist location near the brook and was in young fruit at the time of collection on July 2. The scraggly bushes reached a height of about one meter.

Solidago uliginosa Nutt., var. terrae-novae (T. & G.) Fern. Victoria County: abundant in bog, Ingonish Barrens at an elevation of 1400 feet, *SSSB 4632*; common in bog above Gray Glen Brook, *SSSB 4426*.

Achillea borealis Bong. (*A. Millefolium* L., ssp. *atrotegula* Boivin, var. *atrotegula*). The genus *Achillea* in Nova Scotia is extremely variable. The following specimens, however, are referable to *A. borealis*. The usual weedy character of this genus was not evident in these collections. The plants were confined to specialized habitats and seemed to offer no severe competition to associated species, in one case *Draba norvegica*. Inverness County: small colony on dry exposed cliff shelf, Big Southwest Brook, *SSSB 4563*. Victoria County: rare colonies on exposed cliff of lookoff near bog above Gray Glen Brook, *SSSB 4429;* abundant colonies on exposed headland, White Point, *SSSB 4395* and *SSSB 4397*.

Arnica chionopappa Fern. Inverness County: growing on a nearly perpendicular cliff, locally abundant though not conspicuous, south branch of Grand Anse River near first waterfall, *SSSB 4681*.

II. Records of Plants Rare in the Province

Woodsia glabella R. Br. Reported once previously by Robinson (1904) from near Cheticamp, Inverness County, the following are the only recent collections of this fern. Inverness County: occasional in shaded

crevices of limestone cliffs, Big Southwest Brook, *SSSB 4574;* occasional on cliff, Grand Anse River, south branch, *SSSB 4682.*

Botrychium dissectum Spreng. Previously known from the western part of the province, the following two records represent its known occurrence in Eastern Nova Scotia, the latter being the first report from Cape Breton Island. Pictou County: mixed forest, Lorne, *SCBS 2929.* Inverness County: rare in shaded intervale, spruce-fir woods, Cheticamp River, *SSSB 4754A.* The forma *obliquum* (Muhl.) Fern. was found in both locations.

Botrychium simplex E. Hitchc. This species, although reported at various times from the province, is very rare. It strongly resembles *B. matricariaefolium* A. Br., and its specific identity from this is not marked. The following collections, both of weak individuals, were made in wet habitats. Inverness County: very rare in wet moss, margin of waterfall, tributary of North Aspy River, *SSSB 4584.* Victoria County: small colony in wet mossy shaded bank of Clyburne Brook, *SSSB 4380.*

Schizaea pusilla Pursh. Well known from its local stations in the province, this species was noted to be frequent in the bogs of the interior of the northern Cape Breton plateau. The following two stations record this species from the southeastern part of the province. Halifax County: boggy edge of road to Spruce Hill Lake, *E. Gorham, D. Livingston, J. Lewis, L. Decker, 137.* Cape Breton County: very rare in bog, Belfrey Barren, *SSSB 5113.* The species seems not to persist under severe competition and is therefore found most commonly on recently denuded, damp, usually boggy, areas or associated with mosses, notably *Sphagnum.*

Sparganium minimum (Hartm.) Fries. The following collections satisfactorily reinstate this rare species in the flora of the province. It had previously been known from one collection made by G. E. Nichols in Cape Breton. Inverness County: floating in marginal water of alkaline pool, N. E. Mabou, *SSSB 4861.* Cape Breton County: abundant in water at edge of pond, Bateson, *SSSB 5216.* Victoria County: bog pools, New Haven, *SCBSB 3483.*

Sparganium hyperboreum Laestad. Previously known only from Louisbourg where it was collected by Macoun, it was recollected there in 1951. Cape Breton County: abundant in bog ditch, occasionally fruiting, Fort Louisbourg, SSSB 5391; abundant in bog pool, N. W. Cove, Scatari Island, *SSSB 5241.* Inverness County: fairly abundant in bog pools, French Mountain, *SSSB 4719.*

Potamogeton filiformis Pers., var. borealis (Raf.) St. John. Discovered by Fernald at Baddeck Bay and not seen elsewhere in the province until the following collections were made. Inverness County: abundant in shallow water of Lake Ainslie, Kenloch, *SSSB 4919;* in water of pond, Cape St. Lawrence, *SCBSB 3526;* in pond Hillsborough, *SCBSB 3922.*

Potamogeton Spirillus Tuckerm. Known from the southwestern counties, the following collections show the distribution in the northern part of the province. Cumberland County: underwater, Halfway River, *J. S. Erskine 51.239.* Colchester County: submerged in sluggish stream,

Brookfield, *W. G. Dore and A. E. Roland 994* (DAO). Pictou County: sandy shores of Black Brook Lake, *Eville Gorham,* August 3, 1946 (DAO). Antigonish County: shallow water, Cooper Lake, *Eville Gorham,* July 25, 1946 (DAO). Guysborough County: in river four miles north of Sherbrooke, *J. S. Erskine 51.576.* Richmond County: occasional in marginal shallows of Grand Lake, Isle Madame, *SSSB 5074;* in shallows, Ferguson Lake, *SSSB 5162.* Inverness County: abundant in small brook draining pond, Monk's Head, *SSSB 4761.*

NAJAS FLEXILIS (Willd.) Rostk. & Schmidt. This species has been rarely collected in the province. The collections of the past summer, however, show it to be relatively common. Richmond County: in water of Grand Lake, Isle Madame, *SSSB 5067.* Cape Breton County: abundant in muddy shallows of pond behind beach, Catalogne Beach, *SSSB 5164.* Inverness County: marginal shallows of Lake Ainslie, Kenloch, *SSSB 4910.* Other collections of interest are from Kings County: Tannery Pond, Wolfville, *D. S. Erskine, 751.* Colchester County: in river above Shubenacadie, *J. S. Erskine 51.747.*

GLYCERIA FLUITANS (L.) R. Br. Reported only from swales, ditches, and wet meadows near Truro, Colchester County (Dore and Roland, 1942), the following collection represents the second from the province, and the first from Cape Breton Island. Inverness County: dry sand of lake shore, Kenloch, *SSSB 4942.*

POA ALSODES Gray. Previous to these collections, only one collection was known to exist, although it was reported from Dartmouth in Lindsay's Catalogue (1877). Colchester County: river bank and thickets, St. Andrew River, *SESB 4094;* thickets along Salmon River, Kemptown, *SESB 4077.* Inverness County: banks above MacIntosh Brook, in shaded locations, *SSSB 4228.*

CYNOSURUS CRISTATUS L. Already known from two locations in the province, this introduced grass was discovered abundant in field, Glendyer, Inverness County, *SSSB 4799, SECS 1203.*

TRISETUM SPICATUM (L.) Richter. The exact range of this species, which occurs in Nova Scotia only as the following varieties, has not been satisfactorily known (Dore and Roland, 1942). The following material in the Acadia University Herbarium is therefore of interest. *T. spicatum* var. *molle* (Michx.) Beal—Victoria County: on gypsum near Cape North Village, *SCBSB 3749.* Inverness County: abundant on banks of Cheticamp River, six miles from mouth, *SSSB 4756.* Dore had collected it previously from this general area. *T. spicatum* var. *pilosiglume* Fern.—Inverness County: rare on rocky banks of Cheticamp River, six miles from mouth, *SSSB 4755,* near where Dore had collected it; occasional in rock crevices, Big Southwest Brook, *SSSB 4544.* Victoria County: rare in moist rock crevices, Slaty Point, Clyburne Brook, *SSSB 4374;* occasional in rock crevices, Salmon River, SSSB 4478, *SCBS 2647.*

ELEOCHARIS PAUCIFLORA (Lightf.) Link. var. FERNALDII Svenson. Reported from Baddeck Bay (Fernald, 1921) where it grew on the springy border of a salt marsh, a collection made by Macoun at Grand Narrows,

Cape Breton County, July 27, 1898, antedates the above by twenty-two years. Cape Breton County: locally abundant in very wet sludge-bottomed hollows of quaking bog, one mile north of McAdam Lake, *SSSB 5480.* Inverness County: occasional in quaking mat of calcareous bog, Black River, *SSSB 4969A.*

Eleocharis nitida Fern. This small spike rush, known previously from Belle Isle, Annapolis County (Fernald, 1922), is represented in the Acadia University Herbarium by two sheets from Kings County: Wolfville, *H. G. Perry,* June 15, 1912. Material from Scot's Bay, though immature, seems to fall within the limits of this species, *A. E. Roland 2575.*

Carex spicata Huds. Occasional on margin of pool, Louisbourg Park, Cape Breton County, *SSSB 5392.* This is the first record for Cape Breton Island.

Carex deflexa Hornem. Although not considered rare, the distribution of this species in the province is not well known. The following records may be added to those reported by Roland (1947). Kings County: dryish sandy woods, Church Street, *D. S. Erskine 920.* Queens County: coniferous woods, Lowe's Landing, SECS 271. Victoria County: abundant in rock crevices, tributary of the North Aspy River, *SSSB 4520;* sandy alluvium in woods at edge of Roper Brook, *SSSB 4362.* Halifax County: on path, Musquodoboit Harbour, *W. G. Dore 1437* (DAO).

Carex tonsa (Fern.) Bickn. Queens County: field near camp, Lowe's Landing, *SECS 204.* Lunenburg County: dry sandy roadside, East River, *SECS 345.* Victoria County: locally abundant on gravelly road embankment, near mouth of Warren Brook, *SSSB 4595.* The latter record represents the first collection for Cape Breton Island; the others, first collections from the south shore of the mainland.

Carex conoidea Schkuhr. Roland (1947) reports that this sedge had not yet been collected from Cape Breton. The following collections indicate its presence there. Inverness County: abundant in meadow, Strathlorne, *SSSB 4211.* Victoria County: wet meadow, Iona, *W. G. Dore 1471* (DAO).

Carex atratiformis Britt. First reported by D. S. Erskine (1951), this species has now been found to be fairly common in Northern Cape Breton in rock crevices of brook and river banks. Inverness County: abundant on wet dripping cliff near upper waterfall, Big Southwest Brook, southwest branch, *SSSB 4538;* locally abundant in clumps in rock crevices, Cheticamp River, *SSSB 4722.* Victoria County: very rare in wet rock crevices, Slaty Point, Clyburne Brook, *SSSB 4378.*

Carex castanea Wahl. To the two previous records may be added the following collection. Inverness County: swamp at pond edge, Cape St. Lawrence, *SCBSB 3520.*

Carex capillaris L., var. major Blytt. Although reported once previously from Northern Cape Breton (Erskine, 1951), the past summer's collecting showed this sedge to be characteristic of calcareous rocks, in cool shaded locations on the upper reaches of the northern brooks. Vic-

toria County: abundant on damp mud and wet ledge of calcareous cliff, Gray Glen Brook, north branch, *SSSB 4443*. Inverness County: abundant in rock crevices of limestone cliff, Big Southwest Brook, *SSSB 4558*.

Calla palustris L. Previously thought to be rare or absent in Cape Breton, the following collections indicate its wide distribution there. Cape Breton County: Caribou Marsh near Mira, *G. C. Warren*, July 25, 1948. Victoria County: muddy brook at Baddeck, *John Macoun*, 1898; boggy pond, Big Baddeck, *SECS 1057*. Inverness County: bog, west Lake Ainslie, *SECS 1186*.

Juncus stygius L., var. americanus Bucheneau. To the two known collections of this rare species may be added the following. Inverness County: very abundant at edge of bog pools, French Mountain, *SSSB 4717*. Cape Breton County: shallow trickles through bog near Fort Louisbourg, *SSSB 5390*. Richmond County: occasional in damp hummocks and hollows of bog, Gracieville, *SSSB 5138*.

Smilacina stellata (L.) Desf., var. crassa Victorin. This interesting plant, reported twice from the province (Fernald, 1948), was discovered in Victoria County: rich colony in dry margin of field near coast, Bay St. Lawrence, *SSSB 4480;* grassy slope, east face of Cape North, *SCBSB 3697*. Cape Breton County: rare on exposed headland with the typical variety, near N. E. Cove, Scatari Island, *SSSB 5273*.

Comandra Richardsoniana Fern. Previously collected by Macoun in 1883 from damp sandy soil, Sydney Mines, Cape Breton County, the following collection reinstates the species in our known flora. Victoria County: abundant among grasses and *Empetrum nigrum* L. on exposed headland, Black Point, *SSSB 4339*.

Ranunculus sceleratus L. Reported from the mainland by D. S. Erskine (1951), the following collection represents its discovery in Cape Breton Island. Cape Breton County: abundant in water of swamp hole, Main-a-Dieu, *SSSB 5201*.

Draba norvegica Gunner. This is another species previously collected only by John Macoun (no. 18987), crevices of rock, Big Intervale, Inverness County. A second station for Inverness County: locally abundant on dry exposed shelves of limestone cliffs, Big Southwest Brook, *SSSB 4562*.

Sarracenia purpurea L., forma heterophylla (Eaton) Fern. (var. *terrae-novae* Pylaie, forma *heterophylla* (Eaton) Boivin). This form had previously been reported from Belle Isle, Annapolis County. It has been found to be a frequent form in Northern Cape Breton, occasionally outnumbering the typical form in some of the bogs of the plateau. Inverness County: bog, four miles south of Cabot Trail, North Mountain, *SCBS 2667;* bog, French Mountain, *SCBS 2864*. Victoria County: bog, between Lake of Islands and Sunday Lake, *SCBSB 3598;* common in bog northwest of Cheticamp Lake, *SCBSB 3342*. The following two collections represent single plants found among the typical form. Queens County: swamp, Shelburne River near Lake Rossignol, *SECS 158;* bog, Long Lake,

SCBSB 3293. Occasional intermediate forms were seen in populous colonies of the species.

Tillaea aquatica L. First reported from Cape Breton Island by D. S. Erskine (1951), the following collections were taken from extensive colonies. Richmond County: abundant on flat area near brackish pond, Point Michaud, *SSSB 5135.* Cape Breton County: sandy edge of pond, N. W. Cove, Scatari Island, *SSSB 5355.*

Saxifraga Aizoon Jacq., var. neogaea Butters. Two additional stations of this rare species were found in Northern Cape Breton. Victoria County: very rare on shelf of cliff, Gray Glen Brook, *SSSB 4444.* Inverness County: abundant on dry, sheltered shelves of limestone cliff, Big Southwest Brook, *SSSB 4565.*

Elatine minima (Nutt.) Fisch. & Meyer. Hitherto unknown in the province east of Halifax County, the following collections are of interest. Cape Breton County: occasional in marginal water of Gabarus Lake, *SSSB 5107;* abundant in mucky shallows of pool, Catalogne, *SSSB 5166.* Inverness County: wet sand of pond edge behind beach, West Mabou, *SSSB 5000.* Richmond County: shallow water of second lake west of Loch Lomond, *J. S. Erskine 51.1280.*

Angelica atropurpurea L. Formerly thought to be rare and restricted to coastal areas, this species has been found to be abundant along the upper reaches of the brooks of Northern Cape Breton. Inverness County: bog-meadow, headwaters of the South Blair River, *SCBSB 3802;* gravel beach, mouth of Red River, *SECS 3802;* headwaters of MacKenzie and Red Rivers, very abundant but not collected. Victoria County: seen but not collected, brookside at headwaters of Gray Glen Brook.

Cornus suecica L. Known from two stations, this plant was discovered during the past summer in Cape Breton County: abundant colonies on dry exposed headland, south-east of N. W. Cove, Scatari Island, *SSSB 5354;* very abundant on dry exposed sea-cliff, two miles north of N. W. Cove, Scatari Island, *SSSB 5279.* Although growing in abundance and in association with *C. canadensis* L., × *C. unalaschkensis* Ledeb. was not found.

Vaccinium cespitosum Michx. Reported by D. S. Erskine (1951) as new to the province, the following collection represents its discovery on Cape Breton Island. Inverness County: locally abundant in rock crevices, Cheticamp River, *SSSB 4720.*

Conopholis americana (L.) Wallr. Known only from Fernald and Long's collection (Fernald, 1922) from the LaHave River, Bridgewater, Lunenburg County, the following collections should also be noted. Kings County: oak woods, Belcher Street near Kentville, *R. M. Lewis 1966.* Queens County: in clumps under oaks, back of fish pond, Lake Kedgemakooge, *S. Bleakney* June 29, 1950.

Littorella americana Fern. It was with considerable surprise that this species was collected from several locations on Cape Breton Island. Previously it was known from Shubenacadie Grand Lake, Halifax County, where Mrs. Britton collected it in 1879 (A. Gray, 1880). Richmond

County: abundant in shallow marginal water of Ferguson Lake, *SSSB 5116;* abundant in water of lake margin, Loch Lomond, *SSSB 5056;* very abundant on wet gravelly beach of Grand River, *SSSB 5458.*

Solidago multiradiata Ait. Previously the southernmost known station for this species was on St. Paul Island (Perry, 1931). Inverness County: very rare on moist shaded limestone cliff ledges, Big Southwest Brook, *SSSB 4571.*

Erigeron philadelphicus L. Rare in Nova Scotia, the following represents a third station for the province. Halifax County: large colony in field between Upper Musquodoboit and Dean, *SESB 4123.*

Bidens cernua L., var. minima (Huds.) Pursh. This tiny extreme, known previously from the boggy margin of Hebb's Lake, Bridgewater (Fernald, 1922); bog at margin of sea, Gabarus, C. B., (Rousseau, 1938), was found in a large colony on the sandy shore of Lake Ainslie at Kenloch, Inverness County, *SSSB 4912.*

Material substantiating the majority of these records has been deposited at Acadia University Herbarium.—Perry Biological Laboratories, Acadia University, Wolfville, Nova Scotia.

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SOME RARELY COLLECTED MEXICAN BRICKELLIAS

L. O. Gaiser

While collecting[1] in Michoacan, chiefly around Morelia, and in Jalisco, in the environs of Guadalajara, the writer obtained *Brickellia oliganthes* (Less.) Gray at the base of Mt. Punguato at Morelia and *B. verbenacea* (Greene) Robinson in a little arroyo, near Las Tortugas River on the road to Tequila, about thirty-eight kilometers from Guadalajara. These two closely related species respectively precede and follow *B. reticulata* (DC.) Gray in the Subsection *Reticulatae* of Section *Bulbostylis* in Robinson's monograph of the genus (Mem. Gray Herb. I. 52, 1917). Both have coriaceous and at least partially serrate leaves, the former with short pubescence above and below and the latter scabrous on the margin and slightly so along the veins on the upper side but appearing almost equally green on both sides. The two species are separated in the key on the basis of pedicellate heads in the former and sessile in the latter. *B. verbenacea* is further distinguished by acute rather than mucronate outermost involucral bracts. As there is some variation in the disposition of heads of the inflorescences on larger and smaller stems of one plant, it is difficult to sharply delimit either species by this character. In both, the herbaceous stems arose from a thickened woody caudex.

When returning to Cuernavaca from Jautepec in Morelos, on November 3, 1950, about twenty-three kilometers from the city limits, a single plant[2] which is definitely of this subsection was seen almost hanging over the road from the adjacent mountain side. It was not only gray in appearance as a result of dust from the roadside, but a heavy indumentum covered the stem and both surfaces of the leaves. There were about fifteen stems, of which at least twelve bore some heads, arising from a thick woody base to a height of 7 to 9 dm. While the basal leaves were missing, the internodes were only 1 cm. long, making the stems appear very leafy from the distance of 10 cm. upwards to the base of the

[1] The author gratefully acknowledges a grant from the Penrose Fund of The American Philosophical Society which made possible collection of cytological material as well as herbarium specimens in Mexico.

[2] Specimens of this plant will be deposited at the Gray Herbarium, U. S. National Herbarium, and the Instituto de Biologia, Mexico City.

inflorescence. The lowest leaves were oval, 5 cm. long, 1.5 cm. wide, and almost entire with but very slight serrations toward the apex. The chief inflorescences were corymbs of numerous heads on bracteolate pedicels though the lesser branches bore loose racemes of correspondingly fewer heads on shorter pedicels. The similarity to the figure of *B. reticulata* (DC.) Gray in Robinson, page 52, certainly is striking.

DeCandolle (Prodr. VII. 268, 1836) described the species *Bulbostylis reticulata*, from a specimen collected by Haenke in Mexico without exact locality, as suffrutescent, much branched and entirely tomentose, with almost opposite oval-oblong entire leaves, distinctly reticulate below and with heads axillary and pedicellate, forming leafy racemes. When Gray transferred this to *Brickellia* (Pl. Wright. I. 84, 1852) he suggested, as he stated "after barely having seen it in the herbarium of DeCandolle" that it might possibly be the same as *B. oliganthes* (Less.) Gray, but the latter had narrower serrated leaves and a naked inflorescence. At the time Robinson wrote his monograph on *Brickellia* (loc. cit.) he included *B. reticulata* as described above, but still reported the species doubtfully distinct. Its distribution was not exactly known and with only a poor print of the type specimen at his disposal he left Haenke's specimen as the only reference under that species name. Though Watson (Proc. Amer. Acad. XXII. 421, 1887), in giving the list of plants collected by E. Palmer in the State of Jalisco in 1886 included Palmer's no. 59a as *B. reticulata* with the note that it was a coarser and broader leaved plant than *B. oliganthes*, this specimen at the Gray Herbarium has been annotated by Robinson as "a robust form of *B. oliganthes*."

It has not been possible to compare this recently collected plant with the type in the herbarium at Geneva, but I have had the use of a recently made, improved print from the negative of it at the Gray Herbarium. While this photograph mostly shows a large inflorescence with only the uppermost leaves, comparison certainly suggests great likeness of the new specimen to it. Also additional information has been found concerning the time and region of Haenke's collections. At the Instituto de Biologia in Mexico City, Prof. M. Martinez suggested that I could check on Haenke's travels in Biblioteka Botánico Mexicana by Dr.

Nicholas León, Mexico, 1895. There on page 323, in a brief account of Tadeo Haenke, the author referred to his visit to Mexico and thereafter followed the sentence (here translated). It seems that they arrived at Acapulco in November and returned to the same place in December. Five fascicles entitled "The Mexican Journey" and "Plants of Mexico" were the fruit of this exploration. The road from Acapulco to Mexico City would most assuredly lead through Cuernavaca and southwest from it. The road to Jautepec also goes south to Juitepec and then turns east. Thus Haenke would have made collections along a route less than twenty-three kilometers distant at Cuernavaca from the road beside which the recently collected plant grew.

Only four Mexican species of *Brickellia* were described by DeCandolle. The type specimens for two were Haenke's collections without exact location, Mendez' specimen for a third, and plants of both Haenke and Mendez were seen for a fourth. The three where Haenke specimens were involved are *B. reticulata*, *B. hebecarpa*, and *B. scoparia*, respectively. It is perhaps more than coincidental that although *B. hebecarpa* was not found, the related species *B. glomerata*, which was separated from it mostly on the basis of glomerulate heads, was most abundant at this location, and *B. scoparia* was found within seven kilometers' distance along the same road.

While in the author's collections alone, from three different localities in Michoacan, Jalisco and Morelos, plants were found that do match *B. oliganthes* (Less.) Gray, *B. verbenacea* (Greene) Robinson, and *B. reticulata* (DC.) Gray, as described by Robinson, it may be that the first of these three species should be reinvestigated. As shown by all specimens of *B. oliganthes* in the Gray Herbarium, there is quite a range of variation in the width and nature of the margin of the leaves, in the laxity of the inflorescences where the heads range from subsessile to pedicellate. Also, since the step from acute inner to mucronate or acuminate outer involucral bracts is made within a single head, it is difficult to make a sharp distinction between this species and *B. verbenacea* by outermost bracts when a number of specimens are taken into account. The writer feels that many more collections of these plants, from the countries of Central America as well as Mexico, are necessary before any useful purpose would

be served in attempting the delimitation of *B. oliganthes*, the entity first described by Lessing (Linnaea V. 137, 1830) as *Eupatorium oliganthes*.

There are two other tomentose species of this subsection *Reticulatae*, *B. venosa* (Wooton & Standley) Robinson of northern Mexico and New Mexico, and *B. Kellermanii* Greenman of Guatemala. Both have smaller oblong to linear serrate leaves. In his introduction, Robinson referred to these two species and *B. reticulata* as being very close to *B. oliganthes* in technical characters. However, the plant collected as *B. reticulata* differs from both in its leaves and is known to vary cytologically from an accession of the latter from Arizona.

With the aid of cytological study of meiotic stages, the specimens collected matching both *B. oliganthes* and *B. verbenacea* showed regularity of division and clear metaphase plates of 9 chromosomes (figures in MS. in preparation). However, in *B. reticulata*, a regular plate at first metaphase could hardly be found due to an early dissociation of one or more pairs of bivalents. This kind of irregularity is sometimes associated with hybridization. In this may lie the explanation of the more rarely found tomentose plant with entire leaves.

Because plants in suitable stages for the study of meiosis, often do not have ripe seeds at the same time, it is not known whether this plant of *B. reticulata* would have been fertile. No achenes had matured on it. Where *B. oliganthes* occurred, there were several plants and it was possible to find two more advanced heads on another plant. Of *B. verbenacea*, Mr. Castillo of Guadalajara, who had been with me at the time of collection, obtained seeds by returning at a later time. Thus we know that both of these, as well as *B. venosa*, produced viable seeds. If the incidence of irregular meiosis favors an interpretation of hybridity, so too the size of the inflorescence of Haenke's collection, like the plant of my recent collection, might indicate hybrid vigor.—Biological Laboratories, Harvard University.

Preparing Specimens of Picea and Tsuga.—Preparation of good herbarium specimens of *Picea* and *Tsuga* requires special treatment to prevent the needles from shedding while drying in the plant press. A. J. Sharp (An improvement in the method of

preparing certain gymnosperms for the herbarium. RHODORA **37**: 267–268. 1935) glued the specimen to a herbarium sheet and covered it with cheese cloth before pressing but reported lack of success with boiling. Richard Evans Schultes (The use of formaldehyde in plant collecting. RHODORA **49**: 54–60. 1947) observed that some tropical plants normally difficult to prepare make better specimens after having first been treated with formaldehyde solution. Otherwise, these specimens lose their leaves or leaflets rapidly by formation of an abscission layer. F. R. Fosberg (Formaldehyde in plant collecting. Science **106**: 250–251. 1947), noting that formaldehyde apparently stops formation of abscission layers, suggested this technique for the foliage of *Picea* and *Tsuga* and cones of *Abies*. However, Albert G. Johnson (Effect of formaldehyde on *Picea* and *Tsuga* herbarium specimens. Science **107**: 294. 1948) reported this method unsuccessful. Edgar T. Wherry (A plastic spray for coating herbarium specimens. Bartonia **25**: 86. 1949), describing a plastic spray which forms a transparent film over herbarium sheets, remarked: "At last we have a means for keeping hemlock and spruce needles attached to the stems when pressed!"

While trying to press tree specimens in the tropics where driers could not be changed regularly, I soon learned that some shed their leaves and disintegrated in the moist press. Obviously, these twigs and their thick evergreen leaves lived long enough before drying to form abscission layers and produce poor specimens.

Prompt action to kill the tissues before abscission layers can be formed is more important than the kind of treatment. Discrepancies in effectiveness of treatments may be accounted for by variation in the time of application. A toxic solution should be successful if applied soon enough and long enough to penetrate the tissues. Spraying with the appropriate plant growth regulator might be effective also.

Perhaps the simplest way to kill plant tissues is prompt immersion in boiling water. This method is useful especially with succulents before pressing and probably could be adapted to other plants difficult to press. Boiling water is readily available in the field without cost.

For a few years I have successfully prepared herbarium speci-

mens of *Picea* and *Tsuga* by this easy method. If freshly cut branches are placed in boiling water for one minute or more before pressing, most needles will stay attached upon drying. I boil the the specimens at night after a day in the field. However, good results have been obtained after a longer interval when the specimens have remained moist. As boiling changes the color of the needles slightly, removing the glaucous appearance of the stomatal lines, it is well to press an additional small twig in an envelope or pocket unboiled to preserve normal detached leaves.—ELBERT L. LITTLE, JR., FOREST SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON 25, D. C.

NUTTALL'S DIARY OF 1810 AND SOME INQUIRENDAE.[1]—Thomas Nuttall stands as the best known naturalist of North America in the first half of the Nineteenth Century, after Audubon and Wilson in ornithology and beside Bartram, Michaux, and Pursh in botany. We now have a fairly detailed *curriculum vitae* for Nuttall, particularly from the careful investigations of the late Francis W. Pennell. Dr. Graustein's present contribution to Nuttalliana is fresh and important both for the historian seeking materials on the Old Northwest and for the biologist tracing Nuttall's routes and the sources of his later publications. This overlooked diary of 1810 is here published for the first time, with a short introductory biography, full documentation, identification of the plants and animals mentioned, and appendices of collateral Barton material bearing on this tour. Four of the twenty illustrations are first published here, including an excellent portrait of Professor Benjamin Smith Barton.

This notice of the diary may profitably take the form of an *inquirendae* or "what we still do not know about Nuttall." This memorandum is in no sense a reflection of insufficiency on Dr. Graustein's scholarship but rather a tribute to it for her critical work makes it possible to take inventory of our knowledge of a naturalist of the first importance in American natural history. It is encouraging to know that Miss Graustein is working on a full length biography of Nuttall and these remarks may do service to the task. "He that wrestles with us strengthens our nerves and sharpens our skill." Some questions are these:

(1) What became of the plant collections numbered 1–47 mentioned in this diary? Did any survive in Barton's own collection? My studies under way at the Philadelphia Academy may throw light on this question. (2) Are these plants the ones said to have been shipped by Nuttall from New Orleans in 1811 to B. S. Barton? Nuttall took plants and seeds to England but were these merely duplicates of those sent to Barton? (3)

[1] *Nuttall's Travels into the Old Northwest. An Unpublished 1810 Diary.* Edited by Jeannette E. Graustein. Chronica Botanica, Waltham, Mass. vol. 14, pts. 1/2. pp. 88. *11 plates, 9 text figs.* "1950/51" Issued Feb. 1952. $3.00.

Did Nuttall ever meet Barton again after this tour of 1811? It is unlikely, as Graustein remarks, but possible. (4) Did Nuttall linger in New Orleans until Bradbury arrived there January 13, 1812, or had Nuttall left for England before that date? It is very unlikely that they travelled together down the river from Bradbury's failure to mention that fact. Bradbury left New Orleans on January 20, and a search in the contemporary press may add some details here. (5) To whom in England did Nuttall ship the plants from New Orleans or did he take the collection with him and deliver the seeds and plants presonally to the various parties in England? We know that Nuttall disposed of his seeds to John Fraser for the latter issued a *Catalogue* of Nuttall's Missouri River plants in 1813, and it is likely that Nuttall also placed some seeds in the care of John Lyon, whom he may have met in Philadelphia before the trip of 1810. Loudon says that John Lyon introduced *Amorpha canescens* into cultivation in 1812, but this species may have come from Bradbury's seeds distributed by the Liverpool Botanic Garden. Pursh knew Lyon from his residence in Philadelphia where Lyon succeeded Pursh as gardener at William Hamilton's garden, "The Woodlands," and this may relate to Pursh using Bradbury's collections in the preparation of his *Flora*, along with the access to Lambert's set of Bradbury's Missouri plants made possible through Roscoe. "Piracy" then becomes opportunism. John Lyon is a key figure in this period of American botany, for, like the Frasers, he operated a nursery both in England and America, and was instrumental in the introduction of plants and seeds from Philadelphia as the Frasers were from Charleston. (6) What became of the English reprint editions of Nuttall's *Genera* and of his "Travels into the Arkansa Territory," mentioned by P. A. Whipple in 1852? Were these imprints suppressed for one reason or another, if we are to let their extreme rarity guide our imaginations? (7) Does Barton's copy of Hoffman's *Flora germanica* loaned to Nuttall for the trip of 1810 contain marginal notes bearing on the plant names in this diary? It is possible that this copy has been lost. It is evidently not in the Barton collection now at the library of the Pennsylvania Hospital. There is a two-volume London edition in the Barton purchase at the Hospital. (8) Is the date "18 Sep. 1818" written on the title-page of Nuttall's *Genera* (illustrated as text figure 3 in the Diary) significant as evidence for the date of issue of that work? Pennell says the *Genera* must have been finished in the "autumn of 1818" but this date would seem to be our first precise record bearing on the issue of that classic. (9) The true basis for the publication of Fraser's *Catalogue* (1813) is yet to be clarified; there is no doubt that it represents a seed list for sale of novelties but Nuttall's claim to its authorship by inscribing the Collins copy at Philadelphia is curious. The alliances between the Liverpool Botanic Garden, William Roscoe, A. B. Lambert, John Fraser, John Lyon, and other British nurserymen and cabinet naturalists were so intricate that it is difficult to fix motives and level accusations. That Pursh is blameless in his practices is untrue, as the evidence of his publication of the genus *Bartonia*, the reports of Rafinesque, and others, bear witness, but to make

Pursh the scapegoat of the unfair practices of the times is equally unjust. Competition ran high; funds, low. Friendly encouragement and cooperations were weak or altogether wanting. (10) When Pursh was preparing his *Flora* did he see all of Nuttall's American collections? There is evidence that he saw very few Nuttall specimens. It is more likely that Pursh saw plants grown by Lambert at Boyton from Nuttall's (or Bradbury's?) seeds secured from Fraser's nursery. Lambert's personal copy of Fraser's *Catalogue* in the Amherst College Library might be worth a reexamination on this point. Rickett has traced the history of the Bradbury specimens and has pointed out that "Pursh's species are the duplicates used for exchange by Roscoe." Since Nuttall's seeds from the Missouri River region were peddled by Fraser, and Bradbury's collections taken on the same Astoria Expedition reached William Roscoe in Liverpool, and both Fraser's and Roscoe's cabinets were opened to Pursh, it is difficult to extricate the sources of Pursh's new species in many instances. Significantly, Pursh did not mention *Tanacetum huronense* or *Rubus parviflorus*, two well-marked species described in 1818 by Nuttall from his collections of 1810, which if seen, Pursh would surely have included in his *Flora*. (11) Why did Nuttall's collections remain unstudied in England after his arrival there in 1842? Nuttall had access to the best set of his collections made after his *Genera* but did not take the opportunity to publish upon them while a resident in England where the historic herbaria of London were available to him. (12) May Nuttall be said to have reached the "apogee of his career" at the age of thirty-two upon the publication of his *Genera?* Asa Gray and Miss Graustein believe so, but this reviewer is unconvinced. Nuttall had, rather, two climaxes in his career, with a kind of ornithological interlude between them. His first high success came certainly with the appearance of his *Genera*, to be followed by a second, and greater, climax in the years 1838–48 when he published (or Torrey and Gray "pirated"!) his novelties collected on the Pacific Coast, particularly in California, a few years before. Here he was describing a flora he knew intimately in the field. Haenke, Menzies, Lewis and Clark, Douglas, Chamisso,—none of the botanical explorers before Nuttall had worked on their discoveries so discerningly. He defined "small concrete genera" which have repeatedly been shown to be valid, and his acumen in the recognition of species was notable. Nuttall recognized *Paeonia californica* as distinct from the more northern *Paeonia brownii*, a conclusion verified by Stebbins after Nuttall's species had been carried in synonymy for half a century. In the preparation of the *Genera* Nuttall had excellent botanical precedents, apart from the innovations of that work, but his California papers are marked by bold decisions that have proved him an acute botanist, "who of all the early botanical explorers in California makes the strongest appeal to our scientific understanding and to our intellectual sympathies." JOSEPH EWAN, TULANE UNIVERSITY, NEW ORLEANS, LA.

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